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CONTENTS.

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*THE RELATIONS OF PUBLIC HEALTH SCIENCE TO OTHER SCIENCES.**

"PHYSICAL science is one and indivisible. Although for practical purposes it is convenient to mark it out into the primary regions of physics, chemistry and biology, and to subdivide these into subordinate provinces, yet the method of investigation and the ultimate object of the physical inquirer are everywhere the same."—Huxley.

Physical science is one and indivisible; that, as I understand it, is the key note of this great congress, of which public health science forms one section, and as I am invited to consider, in the brief space of forty-five minutes, the relations of public health science to other sciences, I shall take the liberty of selecting from the whole number of 'other sciences' only a few, the relations of which to public health science seem to me for one reason or another especially important at the present time. I accept the term public health science without hesitation, for any division of human knowledge which has worked out its own laws with strict adherence to the rules of inductive and deductive reasoning, as public health science has done, and which has reached results enabling it to predict with accuracy, as public health science can now predict, is entitled to a place and an honorable place among the physical sciences.

Public health science had its rise and a considerable development in the eighteenth century. Before that time numerous procedures tending to protect or promote the public health had, indeed, at one time or

* Address before the International Congress of Arts and Science, St. Louis Exposition.

another existed, but these were largely empirical and quite as often directed to the convenience of mankind as to their sanitary safety. In this class belong the Mosaic code; the water supply introduced into Jerusalem by Hezekiah; the sanitary engineering of Empedocles; the *Cloaca maxima;* the water supplies of ancient Mycenæ and of Rome, and all the earlier, and too often futile, forms of quarantine. Even the art of inoculation for smallpox was only an ingenious knack introduced from the east, where it had been long used empirically, and although it was a public health measure now of the utmost interest and capable at the time of great practical service, it had until recently no scientific basis, but belonged in nearly the same class as the amulets and charms, the prayers and incantations, of the superstitious.

It was not until the middle of the eighteenth century, namely, in 1767, that Sir George Baker, by the use of the methods of pure inductive reasoning, made the first scientific discovery in public health science in the subdivision of epidemiology, namely, that the epidemic colic of Devonshire, England, was due to an obscure poisoning by lead conveyed through the common cider used for drinking in that district. In 1774 the foundations of state hygiene and sanitation were laid in consequence of the patient investigations and startling revelations of John Howard, by an act of Parliament providing for the sanitation of jails and prisons. The beginnings of marine hygiene and sanitation appear in 1776, when Captain Cook, the navigator, was awarded the Copley medal of the Royal Society for his remarkable success in protecting the lives of his sailors on his second voyage. In 1796 Edward Jenner, working also in a strictly scientific manner, and employing the methods of rigid inductive research, laid securely for all time the foundations of personal hygiene and immunization, by showing how we can produce at will such modifications of the physiological resistance or susceptibility of the human body as to make it immune to smallpox.

The importanee of these fundamental and splendid discoveries, not only to the public health of the time, but far more to the development of public health science in all the centuries to come, is incalculable. Reduced to their lowest terms, we have in these eighteenth century discoveries the germs of some of the most important divisions of public health science as it is to-day, namely, (1) *epidemiology,* (2) *sanitation of the environment,* and (3) *immunization of the human mechanism,* this last the most marvelous phenomenon hitherto discovered in personal hygiene.

Time fails me to do more than name some of the principal steps in the advancement of public health science in the nineteenth century. We have, for example, in 1802, the beginnings of factory hygiene and sanitation; in 1829, the first municipal water filter, one acre in area, constructed for the Chelsea Company of London; in 1834, recognition of the important relation of poverty to public health, in the famous report of the Poor Law Commissioners of that year; in 1839, the beginnings of registration and accurate vital statistics; in 1842, an important report on the sanitary condition of the laboring population of England; and in 1843, a similar report on the health of towns; in 1854, for the first time clearly taught, the lesson, even yet not properly taken to heart, that drinking water may be the ready vehicle of a terrible epidemic of cholera. About 1860, striking epidemics of trichinosis first came into public notice, and here, also, belongs the magnificent work of Pasteur, while in 1868, Lister, following in the footsteps of

Pasteur, revealed to the world the basis of true cleanliness in asepsis, and in 1876, bacteriology became firmly established as a science by Koch's studies on anthrax. The decade from 1880 to 1890 may be called the golden age of ætiology, for in these years were discovered the hitherto unknown parasitic microbes of typhoid fever, tuberculosis, malaria, Asiatic cholera, diphtheria and tetanus. The last decade of a century which has well been called 'the wonderful,' witnessed the discovery of antitoxins by Behring and the beginnings of serum therapy. The list is long, and I have not mentioned nearly all of the discoveries of capital importance, but because of these and their fruits, I am in the habit of saying to my students that with the single exception of the changes effected by the acceptance of the theory of organic evolution, there has been no modification of human opinion within the nineteenth century more wonderful, or more profoundly affecting the general conduct of human life, than that in our attitude toward the nature, the causation and the prevention of disease—that is to say, toward public health science.

No mere outline like this of the history of public health science can possibly serve to show how, like other applied sciences, this one has not grown as a branch grows from a tree, namely, from a large stem or stock of knowledge, tapering out into thin air, and with its latest growth its least and weakest. That common simile in which the various divisions of science are represented as branches of the tree of knowledge, is a grotesque survival of a time when neither trees nor science were understood. No simile is perfect or even approximately correct, but one better than the tree and its branches for the origin and relationships of any inductive science is that of a river, rising from various and often obscure sources, growing in size and importance as it proceeds both from the springs within its own bed and by the entrance and contributions of tributary streams, and finally pouring its substance into the mighty ocean of accumulated human knowledge.

Up to the time of the establishment of the registration of vital statistics in England, in 1839, the stream of public health science, although full of promise, was only a slender thread, but when the results of registration were fully enlisted in its service it visibly widened and deepened. Epidemiology, as has been said, had the honor of giving birth to the science in 1767, and it added to its offspring a rich endowment when, in 1854, Dr. John Snow proved that the water of the Broad Street well in London had caused an epidemic, in which more than six hundred persons died of Asiatic cholera. The stream of public health science was still further enlarged and quickened by the revelation in and after the sixties of the simple causes of numerous epidemics of trichinosis and of typhoid fever, the latter sometimes through milk. There was an extraordinary popular awakening in England to the importance of sanitation and public health measures in the middle of the nineteenth century, but we look for some time in vain for any marked inosculation between public health science and other sciences, such as physics, chemistry, microscopy, bacteriology, climatology, engineering or education. We have, to be sure, minor contributions from the microscopists, such, for example, as that from Dr. Hassall, who, in 1850, made a careful microscopical examination of the water supply of London and showed the presence in the public drinking water of muscle fibers, intestinal parasites and other materials, plainly derived from sewage; but it was

not until Pettenkofer and his disciples, in Germany, and Angus Smith and others, in England, began their splendid chemical investigation that the tributary stream of *sanitary chemistry* enlarged materially that of public health science. In saying this I do not forget that my late friend and colleague, William Ripley Nichols, whose solid contributions to sanitary chemistry were among the first in America, and will always remain among the best anywhere, long ago pointed out that, as early as 1789,

Fourcroy studied the nature of 'litharged' wine, Berthollet (1801) the methods of preserving water for long voyages, Chevreul (1846) various chemical reactions which explain the hygiene of populous cities, and (1856, 1862, 1870) methods of preparing and preserving food; Graham and Hofmann reported upon the use of acetate of lead in sugar refining (1850), upon the London water supply (1851), and upon the adulteration of pale ales with strychnine (1882); Dumas was interested in many sanitary matters and made, among others, reports on the mineral waters of France (1851), on the water supply of Paris (1859), on the treatment of sewage (1867), and on the preservation of food (1870–72); Wurtz was for a number of years president of the *Comité consultatif d'hygiène* and a year before his death was president of the *Société de médecine publique*. His investigations and reports on sanitary subjects are numerous—on the disposal of the waste from distilleries and sugar-refineries, on the colors employed on German toys and in articles of food, on the adulteration of wines, etc.

Other names will occur to us—such as those of Sir Henry Roscoe, Sir Frederick Abel and Dr. Williamson, who served on the Noxious Vapours Commission of 1876; of Frankland, who gave years of service to the Rivers Pollution Commission of 1868 and in connection therewith devised an elaborate system of water analysis; we think also of Schutzenberger devising a method for the determination of oxygen dissolved in water (not, to be sure, simply for sanitary purposes), Mallet studying the various methods of water analysis, Remsen studying the organic matter in the air, and Leeds the practical effect of charging with oxygen (or rather with air) water used for purposes of domestic supply.*

I dwell intentionally upon the service of sanitary chemistry to public health science previous to the rise of bacteriology, because I believe that, dazzled as we have been and still are by the blazing achievements of bacteriology, beginning, let us say, with the discovery of the microbe of tuberculosis by Koch in 1882, students of public health science have been too much inclined to underrate the past services and present relative importance of sanitary chemistry. I know of few more important contributions to public health science, even since 1882, than the chemical work of the State Board of Health of Massachusetts under the able direction of my friend, Professor, afterwards President, Drown (the successor of Nichols) and his associates and successors; or that of another friend, the late Professor Palmer, of the University of Illinois, whose chemical studies of the rivers of Illinois will long remain a monument to a life full of promise and too soon cut short, or that of still another friend, Professor Kinnicutt, who fortunately is still engaged in fruitful work.

I have perhaps said enough, though it would be difficult to say too much, of the magnificent contributions to public health science of Pettenkofer and his disciples in sanitary chemistry; but the work of these investigators in *sanitary physics* and especially the physics of the soil, of the atmosphere, of the walls of buildings, and of heating and ventilation, in their relations to the public health are quite as important, and perhaps to-day even more neglected. In view of the increased facilities for transportation and the growing habit of traveling, together with the tendency to outdoor life, which seem to be characteristic to-day of all civilized nations, the next twenty-five years will probably see a re-

* Wm. Ripley Nichols, address before American Association for the Advancement of Science, *Proceedings American Association for the Advancement of Science*, Vol. XXXIV., 1885.

turn to the patient and exact studies of *the environment,* such as the chemists and physicists began, and have in some measure continued, since the middle of the nineteenth century. These studies will be directed largely to further knowledge and control of the environment, but they will not end there, for *personal hygiene,* owing to recent advances in physiology, is to-day one of the most inviting fields for work and education, and I hardly need to point out to a company of experts that the proper care and right use of the individual human mechanism reacts favorably and fundamentally upon the public health no less truly or effectively than an improved condition of the environment or of the public health tends to promote the welfare and long life of the individual.

The sphere of hygiene may be divided, as it often is, into the two hemispheres, public hygiene and personal hygiene, or it may be cut into one portion dealing chiefly with the human mechanism and its operation (*personal hygiene*), and another portion dealing chiefly with the environment of that mechanism (*sanitation*). The time has gone by when any one person can safely undertake to deal with the whole sphere of hygiene. The physiologist and the physician must in the future leave to the architect and the sanitary engineer such subjects as housing, heating and ventilation, water supply and sewerage, precisely as the sanitary engineer has never presumed to deal with foods and feeding, vaccines and antitoxins, exercise, sleep and rest. The former subjects deal chiefly with the control of the environment, the latter subjects chiefly with the control of the individual, and sanitation and hygiene must henceforward be regarded as separate hemispheres of the science of health.

The *science of architecture,* if under this head we include the principles of building construction, and the heating and ventilation of buildings, has done and is doing much of interest and importance to the student of public health science. For my own part, I am continually more and more impressed with the fact that the air supply, especially for the modern civilized and too often sedentary form of mankind, is in the long run quite as important as the water supply, the milk supply or any other supply. Surely, we can not be too careful of the purity of a substance which we take into our bodies oftener, and in larger volume, than any other, and which has come, rightly no doubt, and as the result of long and painful experience, to be known as the very breath of life. I am well aware that human beings may survive and seemingly thrive, even for long periods, in bad air, but I am certain that for the best work, the highest efficiency, the greatest happiness and the largest life, as well as for perfect health, the very best atmosphere is none too good. Hence I believe that the permeability of the walls of houses and other buildings, and the heating and ventilation of dwellings, school houses, churches, halls and other public places, require, and in the near future will receive, a much larger share of our attention than they have to-day.

In an age characterized by urban life and possessing sky-scrapers, tenement houses and other huge bee-hives, in which human beings aggregating vast numbers spend a large part of their lives, buildings require for their proper construction, lighting, heating, air supply, water supply, gas supply and drainage, the scientific services not only of architects, but of engineers, and such public buildings form one small section of the aid which modern *engineering science* is now everywhere rendering to public health science. The present has rightly been called an 'age of engineering,'

and to no other science, excepting only medicine itself, is public health science to-day more indebted than to engineering science. I have referred above to the construction of the first municipal filter attached to a public water supply as that of the Chelsea Company of London, constructed in 1829. How different is it to-day! Not only nearly the whole of London, but also Berlin and Hamburg, and a thousand lesser cities all over the civilized world, are now protected more or less perfectly from epidemics of typhoid fever, Asiatic cholera and other water-borne diseases by vast municipal filters, ingenious and scientific in design and costly in construction, the work of skillful and faithful engineers, and monuments, more precious, if less enduring, than brass, to the contributions of engineering science to public health science. Innumerable storage reservoirs and vast distribution systems for supplies of pure water also bear witness to the enormous debt which public health science owes to engineering science, as do proper street construction and, still more, those splendid systems of sewerage with which so many modern cities are equipped, and which not only serve to remove quickly the dangerous liquid waste of human and animal life, but also keep low and wholesome the level of the ground water, reducing dampness and promoting dryness of the environment, and thereby strengthening that physiological resistance by means of which the human mechanism fights against the attacks of infectious disease. Nor do the services of engineering science end here, for the fluid content of the sewers must always be safely disposed of, and sewage purification is to-day a problem of engineering science no less important or difficult than that of water purification. These same processes of the purification of water and sewage are matters of so much moment in public health science that in almost every country experiment stations are now maintained at public and private expense for the purpose of working out the most practical and most scientific methods of purification.

In no respect have the services of engineering science to public health science been more conspicuous than in the application and the further study of the principles involved in the processes of water purification. It has lately been shown, for example, that the introduction of pure water supplies has in many cases so conspicuously lowered the general death rate as to make it impossible to escape the conclusions (1) that the germs of a greater number of infectious diseases than was formerly supposed are capable of prolonged life in, and ready conveyance by, public water supplies, and (2), as a promising possibility, that as the result of the greater purity of the water supply the physiological resistance of the consumers of pure water supplies is enhanced, in some manner as yet unknown; the net result being that the general death rate is lowered to such an extent as to lead to a rapid increase of population in communities previously stationary or multiplying far less rapidly. In the case of the city of Lawrence, Mass., for example, I have recently had the privilege of examining the results of studies by the distinguished hydraulic and sanitary engineer, Mr. Hiram F. Mills, which show that since the introduction of a municipal filter, which purifies the water of the Merrimac River supplying water to the citizens of Lawrence, while the population has increased nearly seventy per cent., the total number of deaths remains about the same as it was ten years ago. Mr. Mills concludes from the results of his studies—and I see no escape from his conclusions—that the introduction of the municipal filter has

not only saved the lives of thousands of citizens, but has also caused the population to increase to a point much beyond any which it would have reached had the city continued to use, unpurified, the sewage-polluted water of the Merrimac River. A demonstration of this sort shows how easily the diminishing increase of population under a lower birth rate may sometimes be counteracted without resort to that fish-like spawning which seems to be the only remedy of those who are terrified by 'race suicide,' so called. Moreover, it is hardly necessary to point out that such a diminishing death rate means a far more rapidly diminishing morbidity rate—in other words, it means a heightened working efficiency of the population as a whole, and it must not be forgotten that for most of the results obtained in the scientific purification of water supplies we are indebted to the science of engineering.

On the other hand, we must observe that engineering science, so far as water purification is concerned, is as yet only in its infancy and by no means thus far altogether satisfactory. In the United States, for example, in the last two or three years a number of epidemics of typhoid fever have resulted from the *defective operation or construction* of municipal filters, and while much has been done, it is clear that much still remains to do. In this connection it should be said that public health science in the United States suffers constantly and severely from an unsatisfactory condition of the science and art of administration or government in many American cities. Public health works are too often neglected, delayed, mismanaged or built at extravagant cost, to the sanitary and economic damage of the people as a whole, and the tendency is far too common to place the care and operation of costly devices or systems in incompetent hands. I can not here dwell, as long as I should like to do, upon the mutual relations of public health science and the sciences of legislation and administration. Speaking of my own country alone, I must confess that we are still very deficient in the applications of these sciences. We have not even a national board of health, although we have, fortunately, in the Public Health and Marine Hospital Service a strong substitute for one. The peculiarities of our democratic and republican government have hitherto made it impossible for the people of the United States to secure either from federal authorities or from more local sources that measure of paternal sanitary and hygienic protection which they ought to have, and it is the duty of every American worker in this field to bend his energies toward a better organization of the public health service in every direction, municipal and state as well as national. The appointment in 1886 of a distinguished hydraulic engineer to membership on the State Board of Health in Massachusetts marked an epoch, so far as America is concerned, in both sanitary legislation and administration. This appointment was a formal recognition on the part of the public of the necessity of a larger proportion of engineering science in matters relating to the public health, and the results have justified the new procedure. It is now, fortunately becoming less rare in America to secure the services of engineers upon such boards and there can be no question that participation of the expert laity with medical men is likely to be extended, probably far beyond our present ideas.

In a notable discourse before the International Medical Congress at the Centennial Exposition held at Philadelphia in 1876, Dr. Henry P. Bowditch, of Boston, one of the pioneers of hygiene and sanitation in America, divided the century then

closing, as to its relation to public health science, into three periods, the first, from 1776 to 1832, a period of reliance upon authority and upon drugs; the second, from 1832 to 1869, a period of true scientific observation; the third, from 1869 onwards, an epoch in which the medical profession is aided by the laity and state hygiene is inaugurated. Dr. Bowditch has much to say of the desirability of a wider cooperation of the laity in state hygiene and remarks: 'In all that tends to the promotion of state hygiene hereafter the laity will naturally and cordially cooperate with the [medical] profession.' The history of public health science shows Dr. Bowditch's prediction to have been well grounded. The names of John Howard and Captain Cook in the eighteenth century, and of Edwin Chadwick, John Simon and Louis Pasteur (not to mention a host of lesser workers) in the nineteenth century, show conclusively that public health science has been, even from the start, by no means confined to medical men. We may go further and say that even when forwarded by medical men these have seldom been busy practitioners. Sir George Baker and Jenner were, it is true, of this class, but not Pettenkofer or Koch or Ross or Billings or Reed.*

Reflections of this sort naturally lead to a consideration of the reciprocal relations of public health science and the science of education. I do not need to dwell upon the beneficial effects of public health science upon the hygiene and sanitation of school children or school houses. These benefits have long been emphasized by sanitarians and sanitary reformers, and are sufficiently obvious. The reverse of the picture, however, is by no means so well understood. Unless one is familiar with the facts, it is difficult to conceive how little impression the splendid progress which the last fifty years have witnessed in public health science has as yet made upon the curriculum of education. From top to bottom and from bottom to top the schools, whether primary, grammar, high, normal, technical, medical or any other class, are recreant, inasmuch as they neglect almost wholly any adequate training of their pupils in the principles of public health science, which are confessedly of such profound importance to mankind. There is, to be sure, just now a popular wave of enthusiasm touching the extermination of tuberculosis, but in the United States, at any rate, both schools and universities are singularly negligent of their most elementary duties in this direction. Yet if what I have said before is true, if the laity are to participate from this time forward with medical men in sanitary and hygienic legislation and administration, if engineers and medical men in particular are to serve upon boards of health or in other executive positions connected with public works, then, surely, it is the duty of the science of education to lend its powerful aid and not to fail to save the lives and health of the people as these can be saved to-day, but always to promote that public health and that large measure of consequent happiness which can probably be more easily and quickly accomplished in this way than in any other.

As to the function of medical education and engineering education in respect to the dissemination of public health science, I shall say only a word. In spite of the reiteration by medical men of their belief in the importance of hygiene and preventive medicine as a part of the equipment of the medical profession, it is a significant fact that in America even the

* "During the course of an epidemic physicians are too busy to make observations which require much time or care, or to make more than brief notes."—J. S. Billings.

best medical schools devote very little time to any adequate instruction in these subjects. It may be that this is wise and that the pressing necessities of practical medicine forbid any extended instruction in public health science. I am willing to believe, if I must, that this may be the case; but if it is, then the community must look for the most part elsewhere than to medical men for adequate investigation, legislation and administration of public health science. Medical men, must, of course, always participate in the work, in connection, particularly, with the control of epidemics and in those forms of preventive medicine which have to do with vaccines, serums and other means of modifying the vital resistance of the human body. But as regards the care and control of the environment, medical knowledge is not indispensable, and the entrance of the engineer and the sanitary expert upon the field, as foretold by Dr. Bowditch nearly twenty years ago, is today a conspicuous, and probably a wholesome, fact. As to the attitude of engineering education toward public health science there can be no question. If what I have said before is true, then engineers are bound in the future to take constantly a larger and more important part in public health work, and must be informed, and if possible trained, accordingly. Moreover, as regards both medicine and engineering, the problem is by no means insoluble, for a very short course of instruction rightly given would easily inculcate the necessary fundamental principles, while electives or post-graduate work might enable those few whose tastes led them in this direction to investigate and specialize and more thoroughly prepare themselves for public service.

I can not treat, nor do I need to treat, as thoroughly as I would be glad to do, the mutual relations existing between medical science, especially the science of medical bacteriology, and public health science. These are already sufficiently obvious and well known. From time immemorial medical men have served, often devotedly and sometimes heroically, in the cause of public health science. I take it, however, that since we have in this congress and in our own department a section of preventive medicine, I may pass over without comment this part of my subject.

As regards sanitary bacteriology, however, the relations existing between this and public health science are so fundamental, so extensive and so important, not only on the medical, but also on the engineering side, that although we have also in this congress under the department of biology, as is entirely proper, a section of bacteriology, I may linger at this point for one moment. The bacteria and other microscopic forms of plant and animal life, all of which are conveniently included under the term microbes, have so lately begun to be understood and appreciated that we must still emphasize their extreme importance. The discoveries of the botanists and zoologists and revelations of the microscopists in this domain are comparable, in their importance to public health science, with nothing less than the revelations of the telescope to astronomy. Astronomy had, indeed, existed long before the invention of the telescope, and public health science, as we have shown above, had its beginnings nearly a century before any considerable progress had been made in micro-biology. But it is not too much to say that the developments in microbiology since Pasteur began his work have not only revolutionized our ideas of the nature of the infectious diseases, but have also placed in our hands the key of their complete control.

Concerning the relations of *physiology*

to public health science, I must not fail to speak. Here is a field absolutely ripe for the harvest, but one in which the harvesters are as yet very few. I have lately had occasion to examine somewhat carefully the present condition of our knowledge of personal hygiene—which is nothing more (and should be nothing less) than the applications of physiologial science to the conduct of human life—with the result that I have been greatly impressed with its vast possibilities and promise. Man is a gregarious animal, and mankind is to-day crowding into cities as perhaps never before. Moreover, the industrial and commercial age in which we live is characterized to an extraordinary degree by the sedentary life. Yet the sedentary life is almost unavoidably an abnormal life, or at least it is a life very different from that lived by most of our ancestors. In the sedentary life the maintenance of a high degree of physiological resistance apparently becomes difficult, and if the vital resistance of the community in general is lowered then the public health is directly and unfavorably affected, so that considerations of personal hygiene have a direct bearing upon the science of public health.

There are, to be sure, interesting and suggestive symptoms of a wholesome reaction, in America, at any rate, against the evils of the sedentary life. Parks and open spaces are being liberally provided; public and private gymnasiums are rapidly coming into being; public playgrounds are thrown open in many of our cities, free of expense to the laboring, but, nevertheless, often sedentary, population; vacations are more than ever the fashion; sports and games are everywhere receiving increasing attention; while public baths and other devices for the promotion of personal hygiene are more and more coming into being. All this is as it should be, but all is as yet only a beginning. Here, again, the science of education is sadly at fault and in the direction of educational reform as regards personal hygiene lies immense opportunity for a contribution to public health science.

The science of *statistics*, which has done great service in public health science in the past, is likely to do much more in the future. Without accurate statistics of population, mortality and the causes of sickness and death, the science of epidemiology is impotent, and the efficiency or inefficiency of public health measures can not be determined. And yet in ignorant hands statistics may be worse than useless. It is a matter for congratulation to Americans that we now have in Washington a census bureau permanently established and under expert supervision, but until the various states and cities of the United States follow this excellent example of their Federal Government, one of the most important aids to public health science will continue to be wanting, as is unfortunately too often the case to-day not only in America, but in many other parts of the civilized world.

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SCIENTIFIC BOOKS.

Manual of the Trees of North America (Exclusive of Mexico). By Charles Sprague Sargent, director of the Arnold Arboretum of Harvard University, author of the Silva of North America; with six hundred and forty-four illustrations from drawings by Charles Edward Faxon. Boston and New York, Houghton Mifflin and Company; Cambridge, The Riverside Press. 1905. Pp. 24 + 826, octavo.

A few years ago Professor Sargent brought to a successful close his monumental work, 'The Silva of North America,' in fourteen massive quarto volumes, and including descriptions and figures of 585 species of trees.